

DECLINING REPRODUCTION AMONG SWAINSON'S HAWKS IN PRAIRIE CANADA

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ABSTRACT.—Swainson's hawk (*Buteo swainsoni*) population densities were apparently healthy and reproduction was consistently high in Saskatchewan (2.09 young per successful nest), and in southern Alberta (2.03 young per successful nest) through 1987. Our analysis of 2719 successful nestings revealed that near Kindersley, Saskatchewan, six consecutive years of declining production began in 1988, the worst 6 yr in 25 yr of study. Declines in production were evident at Hanna, Alberta by 1991. In 1993, productivity was only 1.14 young/successful nest near Hanna and 1.27 young/successful nest near Kindersley. The decline in productivity was accompanied by a drastic decline in the number of the Swainson's hawk's main prey, Richardson's ground squirrel (*Spermophilus richardsonii*).

KEY WORDS: *Buteo swainsoni*; Canada; population dynamics; reproductive decline; Swainson's hawk.

Reproducción declinante de *Buteo swainsoni* en la Pradera Canadiense

RESUMEN.—Las densidades poblacionales de *Buteo swainsoni* estaban aparentemente saludables y la reproducción era consistentemente alta en Saskatchewan (2.09 juveniles por nido exitoso) y al sur de Alberta (2.03 juveniles por nido exitoso) durante 1987. Nuestro análisis de 2719 nidos exitosos reveló que cerca de Kindersley, Saskatchewan, que en 1988 comenzó una declinación productiva de seis años consecutivos, los peores seis años en 25 de estudio. La declinación en la producción fue evidente en 1991 en Hanna, Alberta. En 1993, la productividad cerca de Hanna fue solamente 1.14 juveniles por nido exitoso y 1.27 juveniles por nido exitoso cerca de Kindersley. La declinación en la productividad fue acompañada por una drástica declinación en número de la principal presa de *B. swainsoni*, una ardilla de la especie *Spermophilus richardsonii*.

[Traducción de Ivan Lazo]

Swainson's hawks (*Buteo swainsoni*) exhibit a generalist strategy in habitat occupancy and food habits (Schmutz et al. 1980). In western Canada, this hawk chiefly occupies grassland and parkland habitat. Even where these habitats have been substantially modified by agricultural cultivation, the Swainson's hawk remains common (Schmutz 1989). The Richardson's ground squirrel (*Spermophilus richardsonii*) is the main prey of Swainson's hawks throughout Alberta (Schmutz et al. 1980) and Saskatchewan (Houston 1990); the two species have precisely coterminous ranges in Alberta (Wonders 1969).

Swainson's hawk populations were stable in western Canada for three decades, but in 1987, a significant temporary increase in the number of breeding Swainson's hawks occurred in southern Alberta (Schmutz 1989). In this analysis we report on a more recently observed decline in reproduction.

MATERIALS AND METHODS

We studied reproduction and population size in Swainson's hawks by intensively searching for nests and recording their success. Houston's most intensive study area was the vicinity of Kindersley, Saskatchewan (51–52°N, 108–110°W). The area was enlarged in 1987 to include Manton, farther west near the Alberta boundary. Schmutz's area was near Hanna, Alberta, 120 km west of the Saskatchewan study area. The size of the Hanna study area changed over the years (335–480 km²), and we have chosen to standardize the Hanna data on a per 100 km² basis. A complete count of nests and young was made in 1975–77 and 1983–84 (Schmutz and Hungle 1989).

In Saskatchewan, no nests were approached closely during incubation because such disturbance can cause high levels of nest desertion (Houston 1974). Hence, an unknown number of nests had failed prior to the first visit in June or early July. Most often, banding occurred at a second visit, in late July. In Alberta, Swainson's nests were visited for the first time each year in early June. Nest occupancy was recorded without climbing to the nest

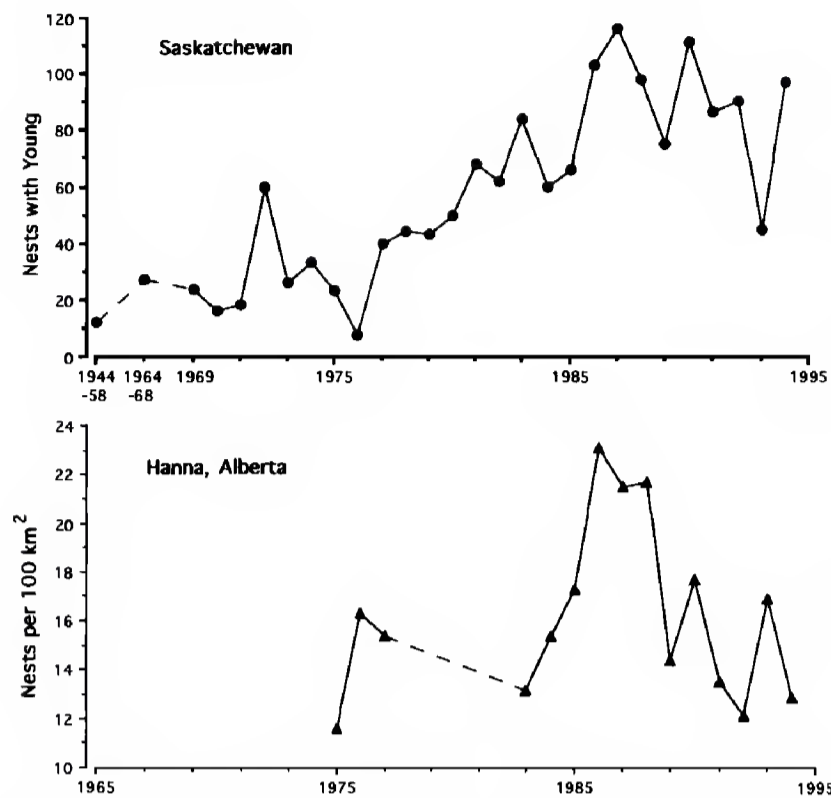


Figure 1. Changes in numbers of Swainson's hawk nests in two study areas. On the Kindersley study area in Saskatchewan incremental increases in searching effort occurred in 1977, 1982, 1985 and 1993-94. The Hanna study area in Alberta (335 or 480 km²) was searched entirely and failed nests were included. The total number of successful nests was 1587 in Saskatchewan and 1131 in Alberta.

except in a few instances when the species of hawk could not be determined without causing the incubating bird to flush. All trees or shrubs within the study area boundary were examined for occupied nests. This method accounted for all or nearly all nesting attempts because even if deserted, nests were carefully inspected after climbing the tree or shrub if there was any indication of occupancy. Minimum evidence required for a breeding attempt was a completed and well-built nest with flattened lining. When no hawks defended such an abandoned nest, species of the occupant was ascertained from the type of nest material used (Schmutz et al. 1980).

RESULTS AND DISCUSSION

Nesting Densities. The number of nests found in Saskatchewan increased with greater search effort in the early years. Additional effort was expended when the drop in nesting pairs was evident again in 1993 and 1994 (Fig. 1).

In Alberta, nesting densities also changed. During three high-prey years (1986-88) densities averaged 22.1 nests/100 km² compared to 14.7 during 12 normal prey years.

Reproductive Success. Reproductive success is our strongest measure of the performance of Swainson's hawks for both populations. We visited both

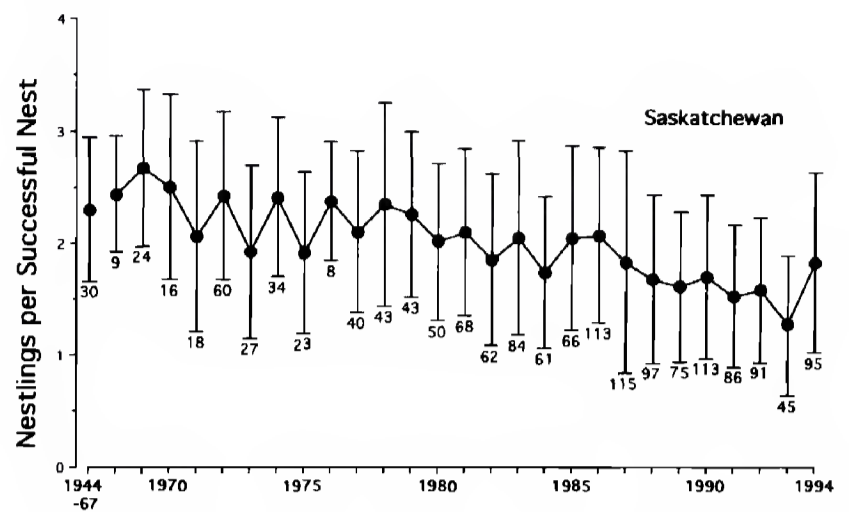


Figure 2. The mean number of nestling Swainson's hawks per successful nest at the time of banding in Saskatchewan. Vertical bars are the standard deviation.

populations for banding in mid-July to early August. Houston banded a total of 3047 Swainson's hawks (1 adult and 3046 nestlings) and Schmutz a total of 2585 (522 adults and 2063 nestlings).

In Saskatchewan, the number of young appeared relatively stable until 1987, with an average of 2.09 young per successful nest (Fig. 2). Beginning in 1988, the Swainson's hawk population showed a decline in productivity. Through 1993, the six consecutive worst years of productivity were recorded, averaging 1.60 young per successful nest, and significantly less than before the decline ($t = 5.73, 22 \text{ df}, P = <0.0001$; Table 1). In 1993, productivity dropped to 1.27 young per successful nest; most pairs failed to raise young and even those that were successful at Kindersley, with three exceptions, raised only a single young per nest. At seven of 45 successful nests that year no adult appeared during 20-min banding visits, presumably because they were foraging at a great distance from the nest due to food shortage. In years of high prey numbers one or both parents were usually present close to the nest. An unprecedented number of failed nesting attempts (71 of 116) was encountered in 1993 (Table 1).

The decline was noticed first at the eastern part of the Saskatchewan study area near Kindersley in 1988 and became apparent 2 yr later at Mantario, Saskatchewan, and 1 yr later at Hanna, Alberta. In each region the decline was correlated with a visible diminution in the numbers of the chief prey, Richardson's ground squirrel, a decline that appeared to spread from east to west.

In 1994, a resurgence occurred at Kindersley to slightly below normal productivity per successful nest

Table 1. Swainson's hawks banded in Saskatchewan.

YEAR	N NESTS OB- SERVED	MINI- MUM FAIL- URE RATE	N YOUNG PER SUCCESSFUL NEST				MEAN N YOUNG PER SUC- CESS- FUL NEST
			1	2	3	4	
1944-1972	—	—	20	61	68	8	2.41
1973	50	46.0	9	11	7	0	1.93
1974	43	20.9	2	19	10	3	2.41
1975	42	45.2	7	11	5	0	1.91
1976	13	38.5	1	3	4	0	2.38
1977	56	28.6	9	18	13	0	2.10
1978	52	17.3	9	14	16	4	2.35
1979	53	18.9	8	16	19	0	2.26
1980	70	28.6	12	25	13	0	2.02
1981	82	17.1	15	32	20	1	2.10
1982	80	22.5	22	28	11	1	1.85
1983	109	22.9	26	32	22	4	2.05
1984	86	29.1	24	29	8	0	1.74
1985	86	23.3	20	24	21	1	2.05
1986	122	14.8	26	48	27	3	2.07
1987	143	19.6	61	19	28	7	1.83
1988	154	37.0	47	35	14	1	1.68
1989	132	43.2	37	30	8	0	1.61
1990	155	27.1	52	44	16	1	1.70
1991	124	30.6	47	32	7	0	1.53
1992	144	36.8	45	38	8	0	1.59
1993	116	61.2	37	4	4	0	1.27
1994	119	20.2	38	37	18	2	1.83
Total	2031	29.6	574	610	367	36	1.91

and above-average success of nesting attempts; this resurgence was not evident at Mantario where six nests fledged only nine young and 11 of 17 nesting attempts failed.

Over the entire Saskatchewan study area, most of the young were produced in nests with two or three young, and only 19% (574 of 3039 hawks) were produced in nests with one young (Table 1). Years when most nests produce only a single young may have serious consequences in regard to annual population replacement.

In contrast to the steady, 6-yr decline in Swainson's hawk reproduction in Saskatchewan, the decline in Alberta took a slightly different pattern. The yearly number of young per successful nest did not vary significantly through 1990 ($r_s = 0.048$, $P = 0.96$, $N = 14$ yr) with an average of 2.03 young per

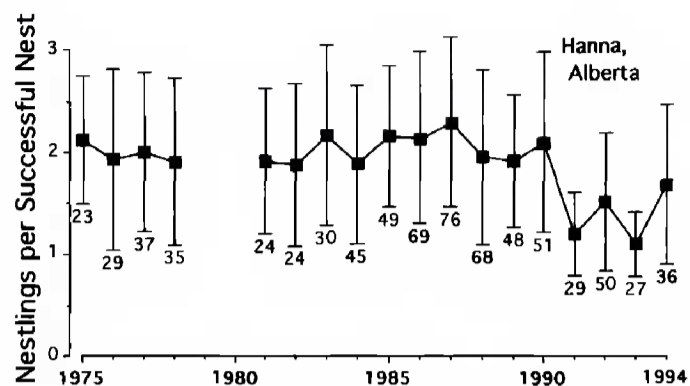


Figure 3. The mean number of nestling Swainson's hawks per successful nest at the time of banding in Alberta. Vertical bars are the standard deviation.

successful nest. Thereafter, in 1991-94, the average was 1.43 young, declining significantly with the year ($r_s = -0.51$, $P = 0.03$, $N = 18$ yr), and being reflected both in the number of young per successful nest (Fig. 3) and in the total number of young fledged on the study area.

The decline in Swainson's hawk reproduction and breeding densities was evident in other studies in Saskatchewan and Alberta. In 1993, Jones (1993) checked 75 previously occupied Swainson's hawk nest sites in southern Alberta, and found only 10 young in six nests.

For both the Hanna and Kindersley study areas, the data are consistent with the interpretation that the recent decline in reproduction is due to an unexplained and substantial decline in ground squirrels. Because declines among Swainson's hawks were widespread, factors operating on the 23 000 km migration route or on the wintering grounds in Argentina (Houston 1990) could also have influenced reproduction. Rappole and McDonald (1994) posed 14 criteria to help determine whether declining species are suffering mainly on their breeding grounds or on their wintering grounds. In the case of the Swainson's hawk, six of the Rappole-McDonald criteria (marginal breeding habitats, declines in optimal and usual breeding habitats, numbers varying with prey cycles, competition and replacement, and decrease in short-migrant grassland species) suggest that the major problem is on the breeding grounds. Eight other criteria they pose, four of which relate to wintering grounds, require further study.

ACKNOWLEDGMENTS

We thank Jean Harris of Kindersley and Dean Francis of Mantario for their assistance in finding nests in Saskatchewan, Alan R. Smith, who shared his Alberta nest

data for 1978, and D.A. Moore, who shared his Alberta nest data from 1981–82. Lynn W. Oliphant and two anonymous reviewers provided constructive suggestions.

LITERATURE CITED

- HOUSTON, C.S. 1974. Mortality in ringing: a personal viewpoint. *Ring* 80:157–161.
- . 1990. Saskatchewan Swainson's hawks. *Am. Birds* 44:215–220.
- JONES, E.T. 1993. Summer '93: a catastrophic year for ferruginous and Swainson's hawk. *Alberta Nat.* 23(4): 14.
- RAPPOLE, J.H. AND M.V. McDONALD. 1994. Cause and effect in population declines of migratory birds. *Auk* 111:652–660.
- SCHMUTZ, J.K. 1989. Hawk occupancy of disturbed grasslands in relation to models of habitat selection. *Condor* 91:362–371.
- AND D.J. HUNGLE. 1989. Populations of ferruginous and Swainson's hawks fluctuate in synchrony with ground squirrels. *Can. J. Zool.* 67:2596–2601.
- , S.M. SCHMUTZ AND D.A. BOAG. 1980. Coexistence among three species of prairie hawks (*Buteo* spp.) in the prairie-parkland ecotone of southeastern Alberta. *Can. J. Zool.* 58:1075–1089.
- WONDERS, W.C. 1969. Atlas of Alberta. Univ. Alberta Press, Edmonton, AB, Canada.

Received 31 January 1994; accepted 22 May 1995